



VP & RPTP Science College-Vallabh Vidyanagar

BSc Examination [Semester: V] 2018

Subject: Physics Course: US05CPHY02

Physics

Monday, Date 01-10-2018

Time: 10.00 am to 12.00 pm

Total Marks: 50

INSTRUCTIONS:

- 1 Attempt all questions.
- 2 The symbols have their usual meaning.
- 3 Figures to the right indicate full marks.

Q-1 Multiple Choice Questions: [Attempt all]

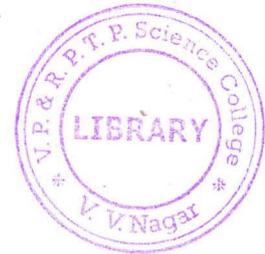
08

- (i) The condition for orthogonality for curvilinear co-ordinates is
- (a) $\frac{\partial r}{\partial u} \cdot \frac{\partial u}{\partial v} = 0$ (b) $\frac{\partial u}{\partial r} \cdot \frac{\partial v}{\partial r} = 0$
(c) $\frac{\partial r}{\partial u} \cdot \frac{\partial r}{\partial u} = 0$ (d) $\frac{\partial r}{\partial u} \cdot \frac{\partial r}{\partial v} = 0$
- (ii) The matrix of order $n \times m$ is obtained from any matrix A of order $m \times n$, by interchanging its rows and columns is called _____.
- (a) Inverse of a Matrix (b) Cofactor of a Matrix
(c) Traspose of a Matrix (d) Adjoint of a Matrix
- (iii) $(1 - x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + n(n + 1)y = 0$ is called
- (a) Hermite differential equation (b) Legendre's differential equation
(c) Bessel's differential equation (d) None of these
- (iv) The generating function for Bessel's function of the order n is
- (a) $e^{\frac{x}{2}(t-1)}$ (b) e^x
(c) $e^{\frac{x}{2}(t-\frac{1}{t})}$ (d) $e^{x(t-\frac{1}{t})}$
- (v) The diffusion equation or Fourier equation of heat flow is
- (a) $\frac{\partial u}{\partial t} = h\nabla^2 u$ (b) $\frac{\partial u}{\partial t} = h^2\nabla^2 u$
(c) $\frac{\partial^2 u}{\partial t^2} = h^2\nabla^2 u$ (d) $\frac{\partial u}{\partial t} = h^2\nabla u$
- (vi) Shift operator E = _____.
- (a) $\nabla + 1$ (b) $\Delta - 1$
(c) $\Delta + 1$ (d) $\delta + 1$
- (vii) $y = ax^2 + bx + c$ is the equation of
- (a) Parabola (b) Ellipse
(c) Straight Line (d) None of these
- (viii) The backward difference operator ∇ defined as
- (a) $\nabla y_i = y_i - y_{i+1}$ (b) $\nabla y_i = y_{i-1} - y_i$
(c) $\nabla y_i = y_i - y_{i-1}$ (d) $\nabla y_i = y_{i+1} - y_i$

Q-2 Answer the following questions in short. (Attempt any Five)

10

- (1) Write Laplacian in terms of orthogonal curvilinear co-ordinates.
- (2) Define Unit matrix and Null Matrix.
- (3) For Bessel's function $J_n(x)$, prove that $xJ_n'(x) = nJ_n(x) - xJ_{n+1}(x)$.
- (4) Write Hermite differential equation.
- (5) Write sine series for $f(x)$, when $0 \leq x \leq \pi$.
- (6) Write telegraphy equation.
- (7) Convert $y = ae^{bx}$ in to equivalent equation of a straight line.
- (8) Define (i) interpolation and (ii) extrapolation.



- Q-3 (a)** Derive expression of gradient in terms of orthogonal curvilinear system. **6**
- (b)** If $u = x + 4, v = y - 5, w = z + 3$, show that u, v and w are orthogonal. **2**

OR

- Q-3 (a)** Prove that the product of sets of two triads of mutually orthogonal vectors are reciprocal to each other. **6**
- (b)** Write expression for $\nabla\phi$ in terms of curvilinear co-ordinate system. **2**

- Q-4** Derive the series solution of Legendre differential equation in the form of descending power of x . **8**

OR

- Q-4** Derive the series solution of Bessel's differential equation in the form of ascending power of x . **8**

- Q-5** Define Fourier series and Derive the expression of Fourier series for a periodic function $f(x)$ in the interval $(-\pi, \pi)$. **8**

OR

- Q-5** Obtain Fourier series for $f(x) = x \cdot \sin x$ in the interval $-\pi < x < \pi$. show that **8**
- $$\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1 \cdot 3} - \frac{1}{3 \cdot 5} + \frac{1}{5 \cdot 7} - \dots$$

- Q-6** Derive Newton's backward difference interpolation formula and evaluate $f(48)$ from the following table of values. **8**

x	10	20	30	40	50
$y = f(x)$	46	66	81	93	101

OR

- Q-6** Using Simpson's 1/3 rule find the approximate value of $I = \int_0^\pi \cos x \, dx$ by dividing the range of integration into ten equal parts. What is the analytical value of $I = \int_0^\pi \cos x \, dx$ **8**